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Research of the Heart Information Monitoring Robert Based on the 3G Wireless Communication Platform

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Abstract

Electrocardiogram (ECG) of a person can be recorded and the diagnostic results can be displayed through touching the heart information monitoring Robert. In addition, the heart rate, phonocardiogram (PCG) and the dynamic three-dimensional echocardiography can also be displayed synchronously. Then the difficult ECG can be transmitted to the service center through 3G wireless communication center, followed by diagnosing the ECG by doctors and transmitting the feedback diagnostic results. I-lead ECG of the person can be recorded by the amplification circuit with high gain and low noise. Then, the heart rate and output phonocardiogram are displayed and the model of heart beat are started to trace through the recognition of R wave. Finally, the difficult ECG is transmitted to the service center via 3G communication chips. The displayed ECG is clear, and the stimulated heart beat is synchronous with that of the person. Furthermore, ECG received by the service center is in accordance with the one recorded by the Robert.

Keywords: ECG; Three-dimensional simulation of heart beat; 3G

1. Method

1.1 Design of hardware

The switch-in of electrocardiogram signal: Through both of the sensors located at two hands of the robot, electrocardiogram signal (I-lead) is recorded; amplified: circuit with high gain and low noise; filter:

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band-pass filter; 50Hz notch filter: special notch filter circuit [1]; Electrocardiogram is collected, stored: standard A/D and RAM; 3G module: EM660.

1.1.1The collection and amplification of signal

Electrocardiogram signal 1 path, 1000 amplification, 0.03-100Hz (Fig.1), AC and EMG interference suppression [2]. A/D converter resolution 12 bit, sampling rate 1KHz/CHN, general 12KHz, serial interface (SPI) [3].

Electrocardiogram with signal breadth of 0-4mV is imported with two spheroid metal contactors as shown in Fig.2. After input protecting, it access cushion level, and it is amplified 5 times by difference amplification, the range of signal is 0-20mV [4].

The signal access band-pass filter with high and low active two level filter, 0.03-100Hz. It is amplified 20 times, the range of signal is 0-400mV.

After treating in 50Hz notch filter, the signal is amplified 10 times; it is adjusted to half the maximum of level monitoring and import into A/D converter after buffering [5].

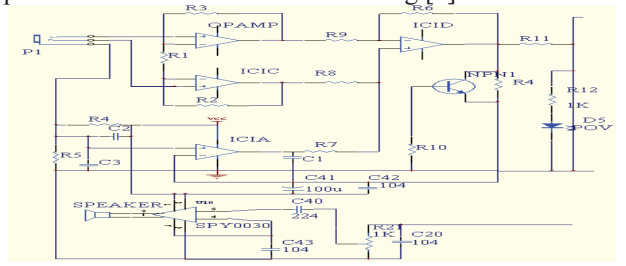

Fig.1 Circuit diagram of collecting module

Fig.2 Schematic diagram of contact sensors

1.1.2 Frame of the system

Block diagram of the system is shown in Fig.3

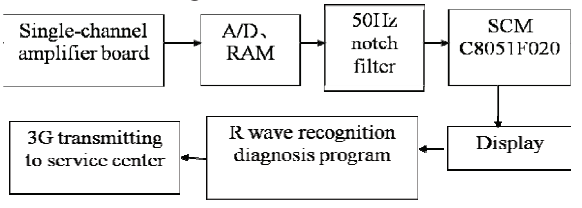

Fig.3 Block diagram of the system

1.1.3 3G module

3G is the abbreviation of 3rd Generation, which means the third generation mobile communication technology. By contrast with the first generation analogue phones (1G) and second-generation GSM,

TDMA and other digital mobile phone (2G), third-generation mobile phones generally, refers to next-generation mobile communication systems combined with wireless communications, multimedia communications and Internet. It can process images, music, video and other media, and it provides web browsing, conference calls, e-commerce and other information services. May 2009, Huawei EM660 module obtained the first built-in 3G network module type approval certificate and license awarded by the Ministry of Industry and Information Technology. And it becomes the first certified by the 3G EV-DO network module [6].

1.2 R wave recognition

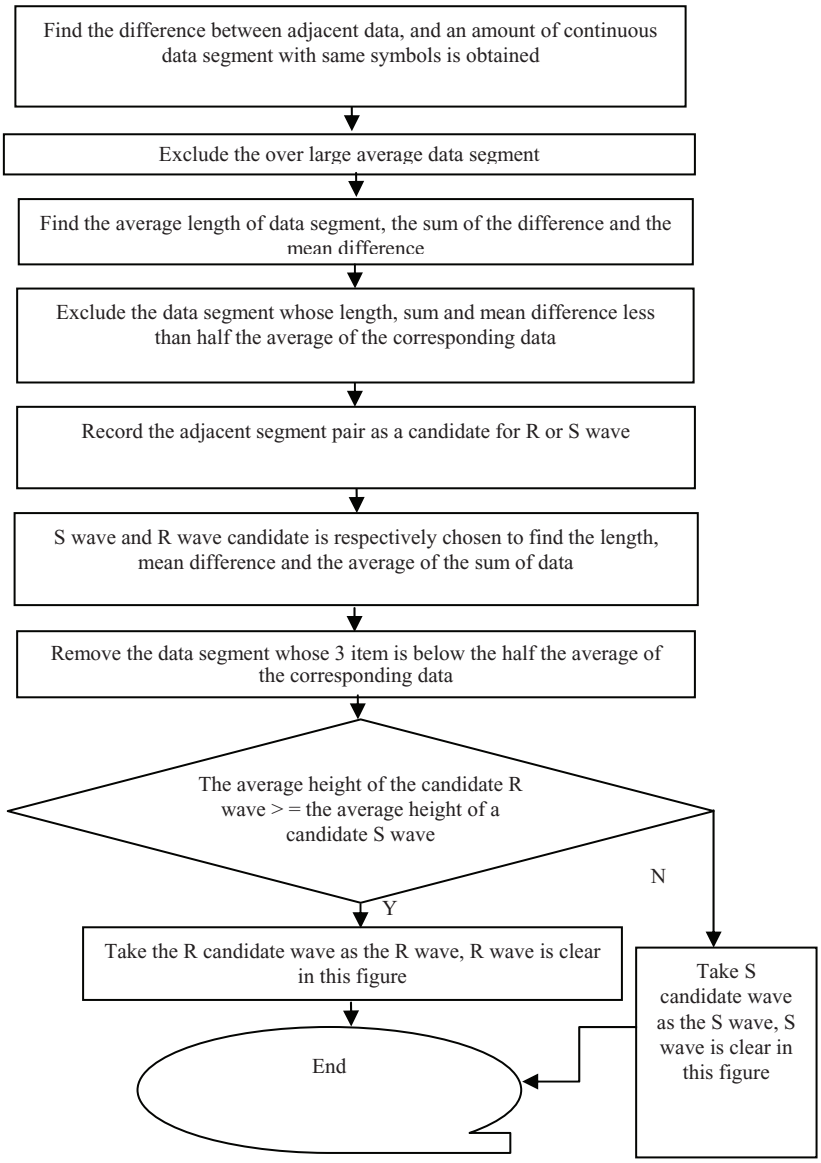

Fig.4 Block diagram of R wave recognition program

R wave program is written in VB, recognition block diagram is as follows (Fig.4).

2. Results and discussion

I-lead ECG recorded by the heart information monitoring Robert is in Fig.5. Baseline of ECG is stable, and a 50Hz interference exits in the recording port signals.

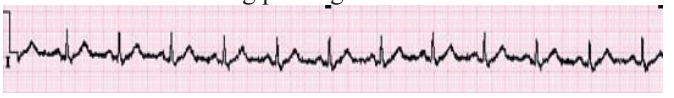

Fig.5 ECG recorded by the heart information monitoring Robert

When the ECG signal is received by the heart information monitoring Robert, the 50Hz interference is wiped off through digital filtering. Waveform is clear and in accordance with the ECG before emitted by 3G network (Fig.6).

Fig.6 Electrocardiogram recorded by the wireless receive port

3G communication data transmission is a novel technique for the transmission of ECG, which is convenient to use, smart in volume, predominant in functions. Therefore, it is the hot issue in the application of telecommunication.

Electrocardiogram transmitted by the heart information monitoring Robert is reliable both in data and stability. Furthermore, the data can be transmitted everywhere covered by the wireless telecommunication network. It should be noted that the high frequency signal interference has influence on the ECG signal. Therefore, digital filtering is applied to enhance the signal quality of electrocardiogram.

ECG data before transmission (I-lead) for P wave, R wave and T wave is 0.2mv, 0.7mv and 0.4mv, respectively. The corresponding data after transmission is 0.19mv for P wave (error: 0.01mv), 0.7mv for R wave (error: 0mv) and 0.39mv for T wave (error: 0.01), respectively. Decrease in signal value is caused by the signal filtering.

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